

Claims

1. Device for needle-free injection of a medium into the tissue of a human or an animal, **characterized by** a needle-free pre-injection device (1, 22, 24, 33, 46) for production of a high-pressure jet of a pre-injection medium for producing an injection channel by means of a high pressure and a small volume, and by a main injection device (17, 21, 23, 34, 47) for introduction of the medium to be injected, with a great volume and a low pressure in comparison with the volume and pressure of the pre-injection device (1, 22, 24, 33, 46).
2. Device as recited in claim 1, **characterized in that** the pre-injection device (1, 22, 24) has a first chamber (4) for accommodating a pre-injection medium, and the main injection device (17, 21, 23) has a second chamber (19, 27) for accommodating a medium to be injected, that a nozzle (2, 32) intended to be set onto the skin is connected with the chamber (4) of the pre-injection device (1, 22, 24) and with the outlet of the main injection device (17, 21, 23) by way of a kick-back valve (5), and that a pressure-production device (14') that is connected with the chamber (4) of the pre-injection device (1, 22, 24) is configured to produce a high-pressure jet from the

nozzle (2, 32) that penetrates the tissue, whereby the chamber (4) of the pre-injection device (1, 22, 24) has a volume sized exclusively for producing an injection channel in the tissue, and the chamber (19, 27) of the main injection device (17, 21, 23) has a volume intended for the medium to be injected.

3. Device as recited in claim 1 or 2, **characterized in that** the chamber (19) of the main injection device (17) has a piston (18) that can be moved by hand.

4. Device for needle-free production of an injection channel in the tissue of a human or an animal, for introduction of a medium to be injected into the tissue, **characterized in that** a pre-injection device (1, 22, 24) is provided ahead of a main injection device (17, 21, 23) that contains the medium to be injected, that a chamber (4) of the pre-injection device provided for accommodation of a pre-injection medium has a nozzle (2) intended to be set onto the skin, and the pre-injection device has a pressure-production device (14') for producing a high-pressure jet of the pre-injection medium that exits from the nozzle (2), and that the chamber (4) has a volume sized exclusively for producing the injection channel.

5. Device as recited in claim 4, **characterized in that** the pre-injection device (1, 22, 24) has a coupling device (9) for a connection with a main injection device (17, 21, 23) that contains the medium to be injected.

6. Device as recited in at least one of the preceding claims, **characterized in that** the pressure-producing device (14', 38, 51) of the pre-injection device (1, 33, 46) has a pressure plate (7) biased by a spring force, or a biased pressure piece (42, 55).

7. Device as recited in at least one of the preceding claims, **characterized in that** the main injection device (17) has a channel (8) connected with the nozzle (2) of the pre-injection device (1).

8. Device as recited in at least one of the preceding claims, **characterized in that** a kick-back valve (5) is disposed within the channel (8).

9. Device as recited in at least one of the preceding claims, **characterized in that** a trigger (11, 40, 57) of the pre-

injection device (1) holds a pressure plate (7) biased by a spring (14) or a pressure piece (42, 55) in its base position.

10. Device as recited in at least one of the preceding claims, **characterized in that** the trigger (11) is connected with the chamber (4) of the pre-injection device (1) and is configured to release the pressure plate (7) above a planned pressure.

11. Device as recited in at least one of the preceding claims, **characterized in that** a membrane (12) is part of the piston (6), with which the chamber (4) of the injection medium is connected, and this membrane (12) activates the trigger (11) by way of a pusher (13).

12. Device as recited in at least one of the preceding claims, **characterized in that** the channel (8) has a connection (3) with the chamber (4) of the injection medium, and that the kick-back valve (5) is disposed between the connection (3) and the coupling device (9).

13. Device as recited in at least one of the preceding claims, **characterized in that** the chamber (8) has a piston (6) that rests against the pressure plate (7) and can be displaced in

length, and that the channel (8) is guided through the piston (6) and the pressure plate (7).

14. Device as recited in at least one of the preceding claims, **characterized in that** the main injection device (17, 21, 23, 34, 47) and the pre-injection device (1, 22, 24, 33, 46) have a common nozzle (2, 32, 36, 49).

15. Device as recited in at least one of the preceding claims, **characterized in that** a trigger (11) of the pre-injection device (1, 22, 24) can be indirectly activated by the pressure produced by the main injection device (17, 21, 23).

16. Device as recited in at least one of the preceding claims, **characterized in that** the pre-injection device (33, 46) and the main injection device (34, 47) have a common chamber (35, 48) for accommodating the medium to be injected, and a common pressure-production device (38, 51), and that the pressure-production device (38, 51) has means for reducing the size of a first, slight part of the chamber (35, 48) in a first step, by a small volume, at a great pressure, and, in a second step, by a great volume, at a low pressure.

17. Device as recited in at least one of the preceding claims, **characterized in that** the common pressure-production device (38) has a single spring (41) and damping means (43) for damping the movement of a piston (37) that delimits the common chamber (35).

18. Device as recited in at least one of the preceding claims, **characterized in that** the common pressure-production device (51) has two springs (53, 54) having different spring stiffness values and spring paths, whereby a first spring element (53) for moving the piston (50) in the first step has a high spring stiffness and a short spring path, while a second spring (54) for moving the piston (50) has a low spring stiffness and a long spring path.

19. Device as recited in at least one of the preceding claims, **characterized in that** the pre-injection medium is a physiologically non-problematic liquid.

20. Device as recited in at least one of the preceding claims, **characterized in that** the pre-injection medium is the medium to be injected or an anesthetic.

21. Method for needle-free injection of a medium into the tissue of a human or an animal, **characterized in that** first, a high-pressure jet of a pre-injection medium is produced, and an injection channel is produced in the tissue by means of the high-pressure jet, and that subsequently, the medium to be injected is introduced into the tissue through the injection channel.

22. Method as recited in claim 21, **characterized in that** the introduction of the medium to be injected directly follows the production of the injection channel, and that a minimum pressure is applied during introduction of the medium to be injected, to maintain the injection channel.

23. Method as recited in claim 21 or 22, **characterized in that** the production of the injection channel takes place at a high pressure and a low volume, and that the introduction of the medium to be injected takes place at a high volume and a low pressure.

24. Method as recited in at least one of claims 21 to 23, **characterized in that** the pressure for producing the injection channel is applied by means of spring force, and that the

pressure for injection of the medium to be injected is applied manually.